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IS 4368 (1967): Alloy steel billets, blooms and slabs for forging for general engineering purposes [MTD 16: Alloy Steels and Forgings]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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**IS : 4368 - 1967**  
**( Reaffirmed 1993 )**

***Indian Standard***  
**SPECIFICATION FOR**  
**ALLOY STEEL BILLETS, BLOOMS AND**  
**SLABS FOR FORGINGS FOR GENERAL**  
**ENGINEERING PURPOSES**

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**BUREAU OF INDIAN STANDARDS**  
**MANAK BHAVAN, 9 BHADUR SHAH ZAFAR MARG**  
**NEW DELHI 110002**

# Indian Standard

## SPECIFICATION FOR ALLOY STEEL BILLETS, BLOOMS AND SLABS FOR FORGINGS FOR GENERAL ENGINEERING PURPOSES

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# **Indian Standard**

## **SPECIFICATION FOR**

### **ALLOY STEEL BILLETS, BLOOMS AND**

### **SLABS FOR FORGINGS FOR GENERAL**

### **ENGINEERING PURPOSES**

## **0. FOREWORD**

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 15 December 1967, after the draft finalized by the Steel Forgings Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** This standard has been prepared based on the experience gained in the production of alloy steel forgings in the country. The steels specified in this standard conform to IS : 1570-1961\*.

**0.3** For the benefit of the purchaser of steels covered by this standard, the information ( see Appendix A ) to be specified by the purchaser while ordering for these steels has been included.

**0.4** This standard contains clauses **5.1, 5.3, 5.4, 6.1.2, 8.1.1, 8.2.1, 9.3, 10.3, 11.4, 11.6** and **12.1** which permit the purchaser to use his option for selection to suit his requirements.

**0.5** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## **1. SCOPE**

**1.1** This standard covers the requirements for alloy steel billets, blooms and slabs for forgings for general engineering purposes.

## **2. TERMINOLOGY**

**2.1** For the purpose of this standard, the definitions of various terms given in IS : 1956-1962‡ shall apply.

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\*Schedules for wrought steels for general engineering purposes.

†Rules for rounding off numerical values ( revised ).

‡Glossary of terms relating to iron and steel. ( Since revised ).

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### **3. SUPPLY OF MATERIAL**

**3.1** General requirements relating to the supply of material shall be as laid down in IS : 1387-1967\*.

### **4. MANUFACTURE**

**4.1** The steel shall be made by open hearth, electric, or any other approved process. Steel shall be of killed type.

**4.2** Sufficient reduction and discard shall be made from each ingot to ensure freedom from pipe, marked segregation and other harmful defects.

### **5. FREEDOM FROM DEFECTS**

**5.1** The material shall be free from harmful internal and surface defects. The method of evaluating the internal defects shall be mutually agreed to between the purchaser and the manufacturer at the time of enquiry and order.

**5.2** The material may be conditioned to remove injurious surface defects, provided the depth of conditioning does not exceed 1 mm for every 15 mm of dimensions concerned, up to a maximum depth of 20 mm, and provided that the width of the conditioning is at least four times its greatest depth; except that in the case of slabs, the depth of conditioning on the wide surface may exceed this allowance by 50 percent, up to a maximum depth of 2 mm. The maximum depth of conditioning on two parallel sides at opposite locations shall not exceed one and a half times the maximum allowed for one side. The transition between conditioned and non-conditioned areas shall be gradual. All heavy swarf or slag shall be removed.

**5.3** In special cases, particularly where it is necessary on large material and is not injurious, greater depth of conditioning may be permitted by agreement between the supplier and the purchaser.

**5.4** Unless otherwise specified, the manufacture shall be at liberty to choose the method of conditioning.

### **6. CHEMICAL COMPOSITION**

**6.1** The ladle analysis of steel shall be as given in Table 1. The analysis of steel shall be carried out either by the method specified in IS : 228† and its relevant parts or any other established instrumental/chemical method. In case of dispute the procedure given in IS : 228† and its relevant parts shall be referee method. However, where the method is not given in IS : 228† and its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.

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\*General requirements for the supply of metallurgical materials (*first revision*).

†Methods of chemical analysis of pig iron, cast iron, and plain carbon and low-alloy steels (*revised*). (Since revised and split into various parts).



TABLE 1 LADLE ANALYSIS AND MAXIMUM HARDNESS VALUES

( Clauses 6.1 and 9.2 )

DESIGNATION (see IS : 1570-1961*)	CONSTITUENT, PERCENT							HARDNESS, HB		
	C	Si	Mn	St	Pt	Ni	Cr	Mo	V	Al
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
				Max	Max					
(1)										(12)
20Mn2	0.16-0.21	0.10-0.35	1.10-1.70	0.050	0.050	—	—	—	—	—
15Cr6.5	0.12-0.18	0.10-0.35	0.40-0.60	—	—	—	0.50-0.80	—	—	—
17Mn1Cr9.5	0.14-0.19	0.10-0.35	1.00-1.30	—	—	—	0.80-1.10	—	—	—
2CMnCr1	0.17-0.22	0.10-0.35	1.00-1.40	—	—	—	1.00-1.30	—	—	—
21Cr1Mo2.8	0.26 Max	0.10-0.35	0.50-0.80	—	—	—	0.90-1.20	0.20-0.35	—	—
07Cr9Mo5.5	0.12 Max	0.10-0.60	0.40-0.70	—	—	0.30 Max	0.70-1.10	0.45-0.65	—	—
10Cr2Mn1	0.15 Max	0.50 Max	0.40-0.70	—	—	0.30 Max	2.00-2.50	0.90-1.10	—	241
13Ni3Cr8.0	0.10-0.15	0.10-0.35	0.40-0.70	—	—	3.00-3.50	0.60-1.00	—	—	—
15Ni4Cr1	0.12-0.18	0.10-0.35	0.40-0.70	—	—	3.80-4.30	1.00-1.40	—	—	—
15Ni2Cr1Mo1.2	0.12-0.18	0.10-0.35	0.60-1.00	—	—	1.00-1.50	0.75-1.25	0.08-0.15	—	—
15Ni2Cr1Mo1.5	0.12-0.18	0.10-0.35	0.60-1.00	—	—	1.50-2.00	0.75-1.25	0.10-0.20	—	—
16NiCr2Mo2.0	0.12-0.20	0.10-0.35	0.40-0.70	—	—	1.80-2.20	1.40-1.70	0.15-0.25	—	—
37Si2Mn9.0	0.13-0.40	1.50-2.00	0.80-1.00	—	—	—	—	—	—	—
37Mn2	0.12-0.42	0.10-0.35	1.10-1.80	—	—	—	—	0.20-0.35	—	—
35Mn2Mo2.8	0.30-0.40	0.10-0.35	1.30-1.80	—	—	—	—	—	—	—
40Cr1	0.35-0.45	0.10-0.35	0.60-0.90	—	—	—	0.90-1.20	—	—	277
40Cr1Mo2.8	0.35-0.45	0.10-0.35	0.50-0.80	—	—	—	0.90-1.20	0.20-0.35	—	—
35Ni1Cr6.0	0.30-0.40	0.10-0.35	0.60-0.90	—	—	1.00-1.50	0.45-0.75	—	—	—
40Ni2Cr1Mo2.8	0.35-0.45	0.10-0.35	0.40-0.70	—	—	1.25-1.75	0.90-1.30	0.20-0.35	—	—
40Ni3Cr6.5Mo1.5	0.36-0.44	0.10-0.35	0.40-0.70	—	—	2.25-2.75	0.50-0.80	0.40-0.70	—	—
25Cr3Mo5.5	0.20-0.30	0.10-0.35	0.40-0.70	—	—	0.30 Max	2.90-3.40	0.45-0.65	—	—
55Si2Mn9.0	0.50-0.60	1.50-2.00	0.80-1.00	—	—	—	—	—	—	235
50CrV2.3	0.45-0.55	0.10-0.35	0.50-0.80	—	—	—	0.90-1.20	—	0.15-0.30	—

\*Schedules for wrought steels for general engineering purposes.

†By arrangement between the supplier and the purchaser, the sulphur and phosphorus contents may be limited to 0.035 percent each

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6.1.1 Elements not specified in Table 1 shall not be added to steel except when agreed, other than for the purpose of finishing the heat, and shall not exceed the following limits:

<i>Constituent</i>	<i>Percent</i>
Chromium	0.25
Nickel	0.30
Molybdenum	0.06
Copper	0.30
Vanadium	0.05
Tin	0.05

6.1.2 Where necessary, more restricted ranges of chemical composition may be specified subject to mutual agreement between the supplier and the purchaser.

## 7. CHECK ANALYSIS

7.1 The check analysis shall be carried out on billets, blooms and slabs. The permissible variations in case of check analysis from the ladle analysis shall be as given in Table 2.

## 8. DIMENSIONS AND TOLERANCES

8.1 Billets, blooms and slabs shall be true to the prescribed dimensions within the tolerances indicated in IS : 3469-1966\* and IS : 1852-1967† respectively for forged and rolled stock.

8.1.1 Subject to mutual agreement between the purchaser and the manufacturer the material may be supplied to closer tolerances also.

8.2 For rolled square billets corner radius shall be about 15 percent of the nominal size.

8.2.1 The tolerances on the length and straightness of the billets, blooms and slabs shall be as agreed to between the supplier and the purchaser.

8.3 The tolerance on weight of billets, blooms and slabs shall be  $\pm 5$  percent of the specified weight.

## 9. CONDITIONS OF DELIVERY

9.1 The steels covered in this standard shall be ordered and delivered on any one or a combination of the following basis:

a) Chemical composition;

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\*Specification for tolerances for steel drop forgings, upset forgings, press forgings and forged bars. ( Since revised ).

†Rolling and cutting tolerances for hot-rolled steel products ( first revision ). ( Since revised ).

- b) As rolled or forged, normalized or annealed;
- c) Maximum hardness;
- d) Hardenability;
- e) Mechanical properties; and
- f) Grain size.

**9.2** If ordered to condition of delivery 9.1(b), or 9.1(c), the product shall have a hardness value below or equal to the maximum specified in Table 1.

**9.3** If ordered to condition of delivery 9.1(d), the complete end-quench hardenability band and hardness, at fixed distance shall be as agreed to between the supplier and the purchaser. The minimum and maximum limits of a specified hardness range shall be consistent with the hardness obtainable in the full range of the specified chemical limits.

**TABLE 2 VARIATION FOR CHECK ANALYSIS**

( Clause 7.1 )

CONSTITUENT	MAXIMUM SPECIFIED RANGE	VARIATION FOR NOMINAL SIZE, mm <sup>a</sup>	
		Up to 250	Over 250 Up to 500
	percent	percent	percent
Carbon	Up to 0.45	0.02	0.04
	Over 0.45 to 0.90	0.03	0.05
Silicon	Up to 0.40	0.03	0.04
	Over 0.40 to 2.00	0.05	0.06
Manganese	Up to 1.20	0.04	0.06
	Over 1.20 to 2.00	0.05	0.07
Nickel	Up to 1.00	0.03	0.03
	Over 1.00 to 2.20	0.05	0.05
	Over 2.00 to 5.00	0.07	0.07
Chromium	Up to 0.80	0.03	0.04
	Over 0.80 to 2.20	0.05	0.06
	Over 2.20 to 5.50	0.11	0.13
Molybdenum	Up to 0.40	0.03	0.04
	Over 0.40 to 1.20	0.04	0.05
Vanadium	Up to 0.15	0.02	0.02
	Over 0.15 to 0.30	0.03	0.03
Sulphur		0.005	0.010
Phosphorus		0.005	0.010

**NOTE** — Variations shall not be applicable both over and under the specified limits in several determinations in a heat.

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**9.4** If ordered to condition of delivery 9.1(e), the mechanical properties shall be in accordance with IS : 1570-1961\*.

## **10. SELECTION OF TEST SAMPLES**

**10.1** Samples for check analysis shall be taken midway between the centre and outside of the material.

**10.2** For tensile tests, the sample shall be taken parallel to the direction of fibre.

**10.3** General conditions for selection and preparation of samples for testing shall be in accordance with IS : 3711-1966† or as agreed to between the supplier and the purchaser.

## **11. TEST**

**11.1 Chemical Composition** — Ladle analysis shall be furnished by the supplier. If check analysis is required, at least one sample shall be taken from each cast and from each size.

**11.2** For material supplied to conditions of delivery 9.1(b) and 9.1(c), at least one sample shall be taken from each cast from each size of each heat-treatment batch. If the material is continuously heat-treated, one sample shall be taken from each 10 tonnes or part thereof, but at least one sample from each cast shall be taken.

**11.3** For material supplied to conditions of delivery 9.1(d), 9.1(e) and 9.1(f) at least one sample shall be taken from each cast for testing.

**11.4** Limits for decarburization shall be as agreed to between the supplier and the purchaser.

**11.5** Hardness test shall be conducted in accordance with IS : 1500-1959‡ and IS : 1586-1960§.

**11.5.1** Tensile test shall be carried out in accordance with IS : 1608-1960 ||.

**11.6 Additional Tests** — Subject to mutual agreement between the supplier and the purchaser, the following optional tests as applicable may also be

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\*Schedules for wrought steels for general engineering purposes.

†Method for selection and preparation of samples and test pieces for mechanical tests for wrought steel.

‡Method for Brinell hardness test for steel. ( Since revised ).

§Method for Rockwell hardness test ( B & C scales ) for steel. ( Since revised )

|| Method for tensile testing of steel products other than sheet, strip, wire and tube. ( Since revised ).

carried out ( method to be agreed to between the supplier and the purchaser till the Indian Standard is published ):

- a) Metallographic test ( structure, non-metallic inclusions, segregation, etc );
- b) Non-destructive test for internal soundness;
- c) Macro-test; and
- d) Any other special test.

## **12. FINISH**

**12.1** Steel may be supplied in any finish as agreed to between the purchaser and the manufacturer.

## **13. RETEST**

**13.1** Should any of the test pieces fail to pass the tests specified, two further test samples shall be selected for testing in respect of each failure. For a single piece of material, the test piece for retest shall be cut adjacent to the original test piece. For billets, blooms or slabs in batches, one of the test pieces for retest shall be taken from the same position, as for the original test piece.

**13.2** Should either of the retests fail to meet the specified requirements, the material represented shall be deemed as not conforming to this standard. However, if the failure with respect to hardness, the batch or test piece may be reheat-treated and resubmitted for testing.

## **14. MARKING**

**14.1** Each billet, bloom and slab shall be legibly marked with the following information:

- a) Steel designation; and
- b) Cast number and identification mark, if any.

**14.1.1** Steel may be suitably painted with colour in accordance with IS : 2049-1963\*.

**14.2** The material may also be marked with the Standard Mark.

**NOTE** — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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\*Colour code for the identification of wrought steels for general engineering purposes.

## **A P P E N D I X   A**

*( Clause 0.3 )*

### **INFORMATION TO BE SUPPLIED BY THE PURCHASER**

#### **A-1. BASIS FOR ORDER**

**A-1.1** While placing an order for the steels covered by this standard, the purchaser should specify clearly the following:

- a) Grade designation;
- b) Description regarding size, length, finish, etc;
- c) Condition of delivery;
- d) Tests required;
- e) Method of manufacture;
- f) Any special requirements; and
- g) Test report, if required.

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